RICE University

George R. Brown School of Engineering

Department of Chemical & Biomolecular Engineering

CHBE 450/550 Petroleum Phase Behavior & Flow Assurance

Spring 2018

Course Syllabus

Instructor

Dr. Francisco M. Vargas
Assistant Professor
Chemical & Biomolecular Engineering
Office: Abercrombie Lab B228
Email: fvargas@rice.edu
Phone: (713) 348-2384

Class Schedule & Location

MW from 4:00 – 5:15 PM, DCH 1075

Office Hours

MW after the class or by appointment.

Course Description

The course reviews the fundamentals of phase and chemical equilibria thermodynamics and focuses on the application of experimental as well as advanced modeling techniques to characterize reservoir fluids and predict their phase behavior and thermo-physical properties. The course is intended for students who would like to develop expertise on PVT modeling, and gain understanding on common petroleum flow assurance problems, such as asphaltene, gas hydrates, wax and scale deposition, and their prediction and mitigation.

Course Pre-requisites & Restrictions

CHBE305, CHBE412

Textbook

There is no textbook for this course. Handouts will be provided by the instructor.

Recommended References

- Smith, Van Ness, and Abbott, Intro. to Chem. Eng. Thermodynamics, 7th Ed, McGraw-Hill, 2004.
- Pedersen, Christen, Azeem, Phase Behavior of Petroleum Reservoir Fluids, CRC Press, 2006.

Course Objectives

Upon successful completion of this course, students will be able to:

- Derive from fundamental principles the necessary equations to model the phase and chemical equilibria of multicomponent systems.
- Understand the experimental methods used for compositional, PVT and Flow Assurance analyses of crude oils.
- Develop computer codes in different platforms to perform simple PVT modeling and for the calculation of thermo-physical properties of crude oils.
- Use commercial packages to perform advanced modeling of the phase behavior of reservoir fluids and identify its limitations.
- Understand the main flow assurance problems in oil production, and the state-of-the-art methods for their prediction and mitigation.

Course Content and Schedule

TOPIC	Week
I. Fundamentals of Phase and Chemical Equilibria Modeling	
1. Laws of Thermodynamics	1
2. Fundamental Property Relations	1
3. Solution Thermodynamics	2
4. Thermodynamic Modeling Using Equations of State	2
5. Multiphase Equilibria Modeling of Multicomponent Mixtures	3
6. Chemical Reaction Equilibria Principles and Applications	4
7. Complex Phase and Chemical Equilibria Problems	5
II. Characterization and Modeling of Petroleum Fluids	
8. Petroleum Reservoir Fluids	6
9. Compositional Analyses and PVT Experiments	7
10. Crude Oil Characterization	8
11. Modeling of PVT and Physical Properties of Crude Oil	9-10
III. Flow Assurance	
12. Asphaltene Deposition, Modeling and Mitigation	11
13. Wax Deposition, Modeling and Mitigation	12
14. Gas Hydrate Formation, Modeling and Mitigation	13
15. Scale Formation, Modeling and Mitigation	14

Policies and Procedures

Academic Integrity

Each student is required to review and abide to the *Honor Code*, which can be found at http://honor.rice.edu/honor-system-handbook/ .

It is the instructor's understanding and expectation that the student's signature on any test or assignment means that the student contributed to the assignment individually and that he or she neither gave nor received unauthorized aid. Authorized aid on an individual assignment includes discussing the interpretation of the problem statement, sharing ideas or approaches for solving the problem, and explaining concepts involved in the problem. Any other aid would be unauthorized and a violation of the Honor Code. This includes referring and copying homework form previous semesters or any solution manuals.

Attendance

Class attendance is mandatory. Students are expected to attend all the classes. Missing a class due to an unexcused absence will be counted as an absence and materials–including homework, quizzes, and exams– cannot be made up. Excused absences may be considered by the instructor. If qualified, homework can be turned in, and although quizzes cannot be made up, the missed quiz grade will be computed using the grade average of the other quizzes.

A total of two late arrivals to class will be equivalent to one unexcused absence. Showing up to class after 15 minutes of commencing will be considered as an absence not a late. Leaving class while the instructor is lecturing is considered to be an impolite behavior and it will be counted as an absence. Try not to leave class unless it is an emergency.

Participation

Participation during the lectures and problem solving sessions is encouraged. Occasionally, the instructor will assign some in-class activities and they might count towards the final grade of the course. If missed due to an unexcused absence, these activities cannot be made up.

Assignments and Computer Projects

Assignments and Computer Projects will be given regularly and they will be due at the beginning of the class on the specified date. Homework and computer problems can be discussed in groups; however, only your own work should be turned in.

Quizzes

Several quizzes will be conducted in the semester and will be based on the material covered during the lectures or the assignments or on the concepts used to solve the computer projects.

Final Project

There will be a final project for those students enrolled in CHBE550. The objective of this project is to apply the concepts and skills developed in this course to solve a specific problem in phase behavior of crude oils and/or flow assurance. The project might include reproduction of simulation results reported in the open literature or analysis and interpretation of new PVT data. Additional documents will be distributed indicating the content and structure of the final project.

Course Grading

Assessment Tool	**CHBE 450**	**CHBE 550**
Participation	5%	0%
Assignments	35%	25%
Computer Projects	40%	40%
Quizzes	20%	20%
Final Project	0%	15%
TOTAL	100%	100%

In borderline cases, student's grade may be raised at the end of the semester if justified by attendance, homework, participation and general academic performance.

If a student believes that an error was made in grading an assignment, quiz or exam, he or she should see the instructor within one week after the corresponding document is returned. For quizzes and exams, it must be noted that the entire paper will be re-graded not just the problem in question, in order to ensure consistence and fairness.

Disruptive Behavior

Disruptive behavior includes any behavior that disrupts the flow of the class. Examples are ringing cell phones, chatting with your classmates, etc. Such behavior is not acceptable and not fair to your classmates and the instructor. Students are encouraged to put their phones on silent mode before entering the classroom.

Instructor's Commitment

Students should expect from his instructor to be courteous, punctual, well-organized and prepared for the lectures and other class activities. Furthermore, instructors should answer the proposed questions clearly; be available during office hours or notify the students beforehand if they are unable to keep them; provide a suitable guest lecturer when they are traveling; and grade uniformly and consistently according to the posted guidelines.

Disabled Students

Any student with a disability requiring accommodations in this course is encouraged to contact the instructor after class or during office hours. Additionally, students should contact Disabled Student Services in the Ley Student Center.